

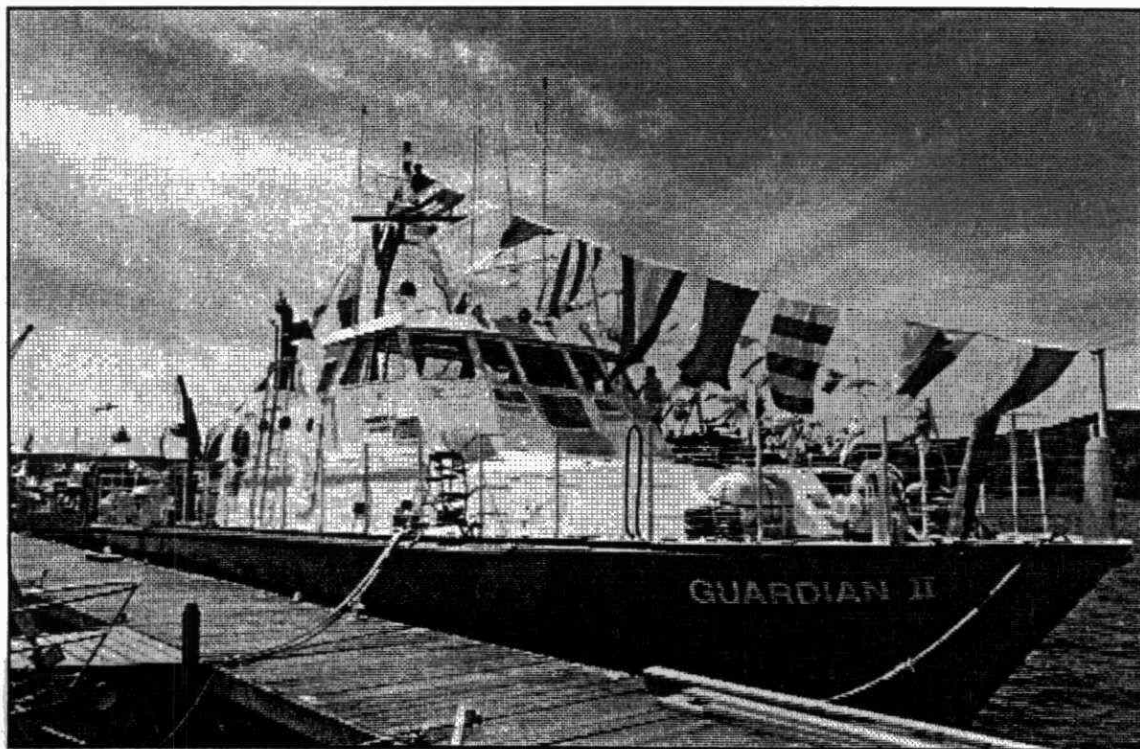
STANDARDS DEVELOPMENT BRANCH OMOE



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**GREAT LAKES SECTION  
ACTIVITY SUMMARY  
1990-1991**



**TD  
223.3  
.W3  
G7  
1991  
MOE**

**WATER RESOURCES BRANCH  
MINISTRY OF THE ENVIRONMENT**

**TD  
223.3  
.W3  
G7  
1991**

Great lakes section activity  
summary : 1990-1991 /  
76802

GREAT LAKES SECTION  
ACTIVITY SUMMARY  
1990-1991

Water Resources Branch  
Ontario Ministry of the Environment

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## FOREWORD

This 1990-1991 Activity Summary was prepared to summarize the wide range of work undertaken by the Great Lakes Section of the Water Resources Branch during the last fiscal year. The introductory material provides an overview of the various programs supported by the Section, the subsequent chapters provide a complete list of all 1990 -1991 projects related to these programs, and the final section lists publications and presentations by Section staff during the year.

This information is provided as reference for a diverse range of readers. The initial overview is intended to provide program managers within the Ministry, as well as other Provincial and Federal agencies, with basic information concerning the current mandate of the Great Lakes Section. We hope that this will assist in planning and coordinating future program activities.

The more detailed information is provided for use by all those associated with, or interested in, Great Lakes environmental issues. The intention is to ensure that anyone who so desires can pursue details pertaining to their particular area of interest, whether they represent provincial, federal, or municipal agencies, universities, or consultants. By making this summary widely available we are endeavouring to improve access to technical staff within the Section. Given the wide range of environmental issues and challenges in the Great Lakes Basin, we hope that such access will ensure that future projects benefit from as wide a range of discussion and coordination as possible.

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## 1. INTRODUCTION

The Great Lakes Section mandate is to protect and enhance receiving water quality and the aquatic ecosystem in the nearshore waters of the Canadian Great Lakes and connecting channels.

The Section undertakes work in a variety of programme areas including:

- (1) Remedial Action Plans (RAPs) in conjunction with the federal government, through the Canada-Ontario Agreement Respecting Great Lakes Water Quality (COA), MOE Regional offices, MNR, and other provincial and municipal agencies, in support of Annex 2 of the Canada-United States Great Lakes Water Quality Agreement (GLWQA),
- (2) Nearshore Monitoring as part of the provincial COA commitment to the Great Lakes International Surveillance Plan (GLISP) under Annex 11 of the GLWQA,
- (3) Municipal Industrial Strategy for Abatement (MISA) receiving water impact assessment,
- (4) Support for Regional Office investigations into the impacts of regulated point-source discharges under the Ontario Environmental Protection Act and Ontario Water Resources Act, and
- (5) Monitoring and mathematical simulation modelling methods research, development, and technology transfer for MOE Regional offices and private sector organizations.

These commitments require that the Section maintain expert knowledge of aquatic ecosystem (water, sediment and biota) conditions in the Great Lakes and connecting waterways. This knowledge is applied to assess compliance with provincial and international water, sediment, and biological objectives, and to interpret water use suitability for aquatic life, recreation and water supply.

Great Lakes Section activities:

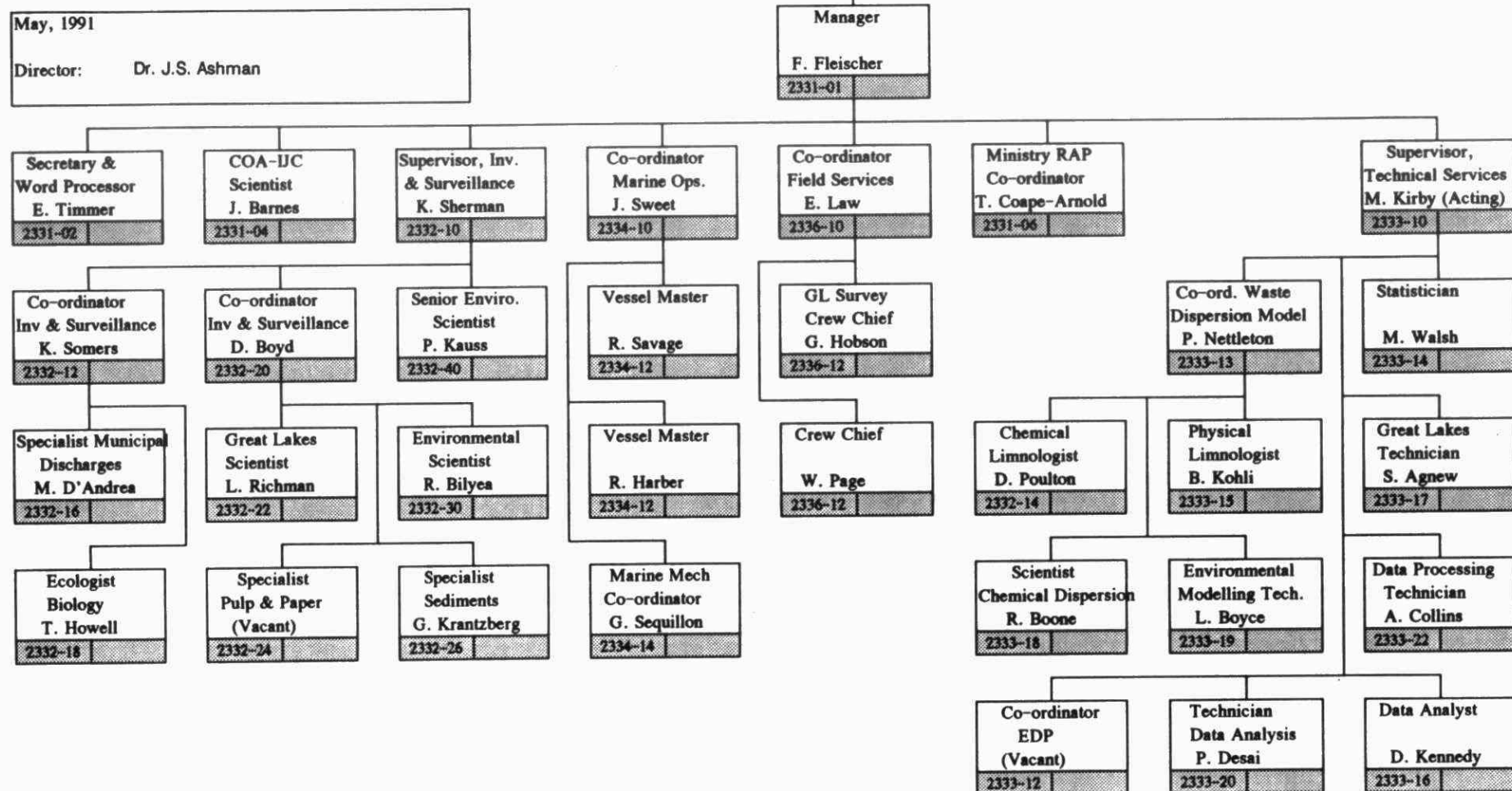
- define the impact and cause of water use interference,
- assess the effectiveness of remedial programs and controls and define abatement measures required to restore beneficial uses,
- investigate and identify emerging problems; provide early warnings of and speedy response to new issues,
- evaluate water quality trends as evidence of effectiveness of control programs,
- develop new approaches and technologies for field data collection, computer data analysis and presentation,
- develop and apply computer simulation and prediction models for chemical spill assessment, chemical fate and transport and physical water movements,
- coordinate the development and implementation of Remedial Action Plans on behalf of the province, ensuring the effective use of available resources and development of appropriate management frameworks.

**Ministry of the Environment  
Water Resources Branch Organization Chart 4  
Great Lakes**

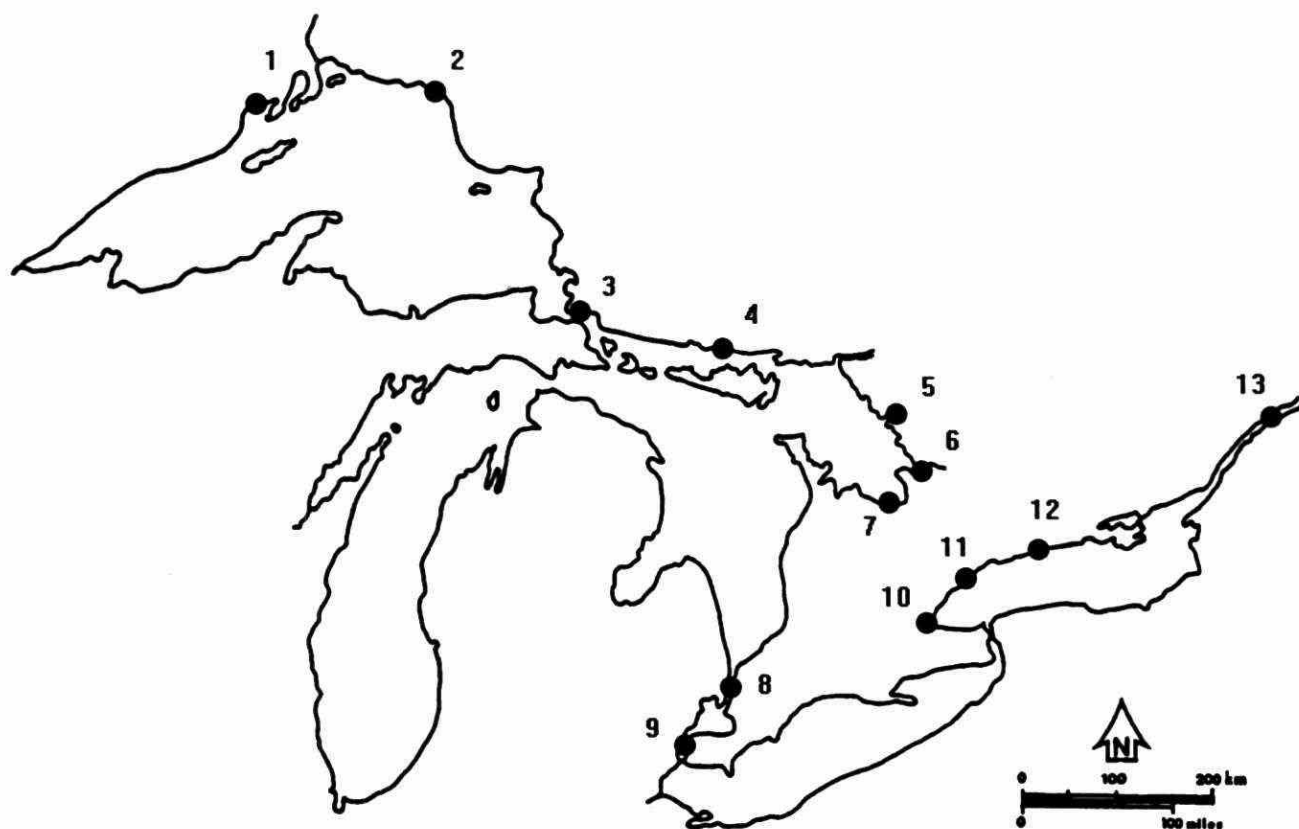
May, 1991

Director: Dr. J.S. Ashman

To Position 2302-03, WRB Chart 1



## 1990-91 Sampling Locations



- |                        |                                |
|------------------------|--------------------------------|
| 1. Thunder Bay         | 8. St. Clair River             |
| 2. Peninsula Harbour   | 9. Detroit River               |
| 3. St. Mary's River    | 10. Hamilton Harbour           |
| 4. Spanish River       | 11. Toronto Waterfront         |
| 5. Parry Sound         | 12. Port Hope Harbour          |
| 6. Severn Sound        | 13. St. Lawrence R. (Cornwall) |
| 7. Collingwood Harbour |                                |

**Basin-wide Projects:** Tributary Monitoring (Lake Huron)  
Long Term Sensing Sites (Niagara R. & Lake Ontario)

## 1990 GREAT LAKES SURVEILLANCE PROGRAM

	APRIL					MAY					JUNE					JULY					AUGUST					SEPTEMBER					OCTOBER					NOVEMBER				
	26	02	09	16	23	30	07	14	21	28	04	11	18	25	02	09	16	23	30	06	13	20	27	03	10	17	24	01	08	15	22	29	05	12	19	26				
THUNDER BAY WATER & SEDS												5	5	5								5																		
PENINSULA HARBOUR UNDERWATER CAMERA																					5																			
ST. MARY'S RIVER SED & BENTHOS																							5																	
ST. MARY'S RIVER (CURRENTS ADCP)																																								
SPANISH RIVER SED & BENTHOS																6	6																							
HURON - GEORGIAN BAY TRIBS											T				T																									
SEVERN SOUND SED & BENTHOS												6																												
PARRY SOUND SED & BENTHOS															6	6	6			6				6																
COLLINGWOOD TRIB FLOWS			T				T				T				T					T				T				T							T					
COLLINGWOOD MUSSELS & SEDS							6				5																													
ST. CLAIR RIVER SED & BENTHOS									6	6	6	6																												
ST. CLAIR DELTA FLOW & PROFILES																			5															6						
DETROIT RIVER PLUME TRACKING (ALLIED CHEM.)																				5												6*								
DETROIT RIVER DISPERSION STUDY																					5												6*							
HAMILTON HARBOUR SED & BENTHOS							5																																	
HAMILTON HARBOUR CENTRIFUGE SUSP. SOLIDS		T/5					T/M				T/M							T/M					T/M		T/M		T/M				T/M				T/M					
HAMILTON HARBOUR BACTI																M			M		M		M	A																
LONG-TERM SENSING SITES '90								5	5						6	6										5	5			5	5									
PORT HOPE SEDS							6																					5												
CORNWALL BACTI									M					M				5				M			M															
CORNWALL SEDS																	5																							
CORNWALL (CURRENTS ADCP)																						6														6				
No. Crews Required	1	1			1	1	2	2	3	2	3	3	3	3	3	3	3	3	2	2	3	3	2	2	1	1	2	1	1	1	1	1	1	1	1	1				
No. Vessels Required	1day				1	1	2	2	3	1+1d	3	3	3	2+1d	3	3	3	2+1d	2	2	3	2+1d	2	2	1day	1	1	2	2	1day	2	2	1	1day						

T - TRUCK

5 - MONITOR V

M - MONARK

G - GUARDIAN II

6 - MONITOR VI

A - JAMES AULD

Revised: March 5, 1990

April 12, 1990

May 28, 1990

\* Peter Nettleton to provide office crew.

March 6, 1990

April 17, 1990

Aug 8, 1990

March 8, 1990

April 20, 1990 am

March 14, 1990

April 20, 1990 pm

March 21, 1990

April 23, 1990

April 9, 1990

May 17, 1990



## 2. 1990-1991 PROJECTS

### 2.1 Lake Superior

#### Lake Superior Embayment Biomonitoring

Ten sites in five selected embayments of Lake Superior were sampled in August 1989 for Mysis relicta, the opossum shrimp, to assess the nearshore contaminant uptake. The nearshore of Lake Superior provides a range of embayment quality due to the effect of industrial discharges and to the degree of exchange with the open lake. The shrimp Mysis offers a localized biomonitor in suitable quantity, that has a higher lipid content for enhanced concentration of organic contaminants.

All but one of the ten sites selected had sufficient mysids for tissue analysis. Analysis for bulk composited samples is expected by April 1991. A preliminary report will be available by July 1991.

A cooperative study agreement was established with Trent University to provide microscopic examination (size, stage and sex) and individual organism analysis for cadmium. A draft report on the cadmium analysis and microscopic examination was received in November 1990. The final report including the literature review of mysids as a biomonitor is expected by August 1991.

Keith Sherman (416) 323-4951

#### Thunder Bay Outer and Northern Harbour Baseline Study

The northern part of the outer harbour in Thunder Bay receives the effluent discharge for both the Abitibi-Price Provincial Papers mill and the Abitibi-Price Thunder Bay Division pulp and paper mill. The intake for Thunder Bay's drinking water supply is also located in this area. In addition, a proposed BCTMP mill plant will discharge to this area.

Previous surveys have primarily concentrated on the Kaministiquia River and the inner harbour as the areas most affected by industrial and municipal discharges, and the outer and northern harbours have received only cursory attention. A comprehensive water and sediment quality survey was completed in October 1990 to determine impacts from the two mills and to establish baseline conditions to evaluate potential impacts from the development of the proposed BCTMP mill.

Currently, laboratory results for some organic analyses remain outstanding; all analyses are expected to be completed in May 1991. Water and sediment samples were analyzed for conventional parameters, metals, nutrients, bacteria (water only) and organics (chlorophenolics, speciated phenolics, organochlorines, resin and fatty acids, and volatile organohalides). Mussel samples were analyzed for metals and organochlorines, and leech samples for organochlorines and phenolics.

Findings will be included in the Stage 2 RAP report, and will be presented in a summary report under separate cover.

Duncan Boyd (416) 323-4949

#### Thunder Bay Environmental Impacts

It was proposed that a depth integrated hydrodynamic and water quality simulation (RAND) model be applied in the vicinity of the mouth of the Kaministiquia River. Seven self-recording current meters were operated from June to October 1988 to gather input data. Water quality monitoring at selected stations was also carried out during the period to provide calibration/validation for the water quality simulation. After the RAND modelling is completed, the results will be utilized in a fate and transport model to assess the fate of selected water quality parameters as the contaminant is transported from effluent discharges.

The data have already been analyzed; modelling and the report are scheduled for completion by December 1991.

Balbir Kohli (416) 323-4961

#### Nipigon Bay Sediment Survey

Field work was completed during the period July 25-August 5, 1988. Approximately 50 sediment and suspended sediment samples were collected, in addition to 2 grab samples of Domtar effluent, the Red Rock STP effluent and Nipigon River tributary input. Parameters selected for analysis included metals, dioxin, particle size, PAHs, chlorinated aromatics, chlorinated phenols, and organochlorines. Laboratory analyses are complete. Results indicate two patterns in sediment contamination in the Bay, one though to be associated with discharges from Domtar and the second, with depositional basins in Lake Superior. A follow-up survey will be conducted in 1991 to confirm this hypothesis. The results of the present survey are to be issued as a file report.

Mary Kirby (416) 323-4957

#### Jackfish Bay Environmental Study

Surveys conducted by Great Lakes Section in 1987 and 1988 were required for an understanding of the cause-effect relationships between current contaminant sources and environmental conditions, as well as to establish a data base for Blackbird Creek and Jackfish Bay, to assess the effectiveness of new control programs by Kimberly-Clark (1987, 1988). In addition to reporting on 1987 field work, suspended sediment quality, sediment coring, surficial sediment sampling, and a sonar survey of selected portions of the bay were undertaken in 1988.

The consultant's reports on the 1987 and 1988 sonar survey have been received; a poster paper was presented at the IAGLR conference in May 1988. A report on the 1987 benthic survey was distributed as a RAP document in April 1989. Final sample analyses for sediments were received in February 1989 (with the exception of core samples), and a poster paper of the surficial sediment quality status of the Bay was presented at the Conference of the Canadian Pollution Research in Burlington in February 1989. An oral paper was presented on dioxins and furan results at the Dioxin 89 Conference in September 1989. The text of the paper has been published (Chemosphere 20:(10-12):1641-1648). A data report will be completed by March 1991. A chapter covering water, sediment and biota results from 1987 and 1988 is currently under preparation for the Jackfish Bay RAP Stage 1 report. The first draft of this chapter will be completed by April 1991. A final draft report on the study will be completed by October 1991. As the company has installed secondary treatment (fall 1989), additional sampling will be undertaken in 1992.

Keith Sherman (416) 323-4951

#### Jackfish Bay Physical and Chemical Transport

Nine current meters were deployed during July and August 1987 to provide input and calibration data for hydrodynamic and water quality simulation modelling. The current meter data analyses have been completed. The modelling was completed by a consultant and a final consultant report was submitted to the RAP Team in April 1990. The modelling will be used by the RAP Team to assess the effectiveness of new control programs incorporated by Kimberly-Clark.

Balbir Kohli (416) 323-4961



## Peninsula Harbour Sediment and Bioavailability Study

A surficial sediment survey was conducted in July 1989 at 60 stations in the Peninsula Harbour/Lake Superior area. The samples were analyzed for metals, nutrients, particle size, organochlorines, chlorophenolics, speclated phenolics and resin and fatty acids. Selected samples were also analyzed for dioxins and furans. Sediment cores were taken at 5 locations primarily to determine historical deposition of mercury and chlorophenolic compounds. Mussels and leeches were placed at 5 locations to determine accumulations and retention of metals and chlorophenolic compounds, respectively. Analyses of the metals, nutrients and particle size parameters has been completed in the surficial sediment samples; however, the analyses for the organic parameters is still in progress. Hepta- and octachlorodioxins and furans were detected in depositional areas out from the pulp and paper mill discharge. No tetrachlorodioxins or furans were detected. The mussels in Jellicoe Cove accumulated mercury to a maximum of 0.05 ug/g wet weight in Jellicoe Cove after a 61 day exposure. The leeches placed adjacent to the mill effluent diffuser accumulated concentrations of 2,4,6-trichlorophenol to a maximum 2.8 ug/g wet weight. A follow-up study including methyl-mercury analysis and sediment core dating has been planned for the summer of 1991. Completion of the 1989 reporting is contingent upon the replacement of the Pulp & Paper Specialist position.

Ian Smith (416) 323-4920

## **2.2 Upper Connecting Channels**

### St. Marys River Pilot Site Synthesis Report and Component Reports

Three component reports are being prepared for the 1986-87 pilot site study: (i) Impact of Effluents; (ii) Long-Term Effluent Monitoring; (iii) Sediment Cores and Surficial Sediment Quality. Data checking and compilation are still underway for (i), a draft report is in preparation for the long-term effluent monitoring and the sediment data. Preliminary hydrodynamic/dispersion and fate/transport modelling has been completed (consultant). The final modelling report will be completed by September 1991. Completion date for the draft synthesis report is estimated at December 1991.

Peter Kauss (416) 323-4952

### St. Marys MISA Modelling

In 1987, two hydrodynamic/dispersion models were applied to the upper and lower St. Marys River, to study the water column behaviour of discharged effluents from Algoma Steel. An extensive field data gathering exercise was also conducted, to provide a data base which in part would be used to calibrate fate and transport and aquatic food chain models. Lab analysis of 1987 data has been virtually completed. Data analysis is expected to be completed by October 1990. Once completed, the analyzed data will be sent to the modelling contractor to complete the modelling and derivation of water quality based loading limits for key chemicals. The projected date of the final report is March 1991.

Peter Nettleton (416) 323-4964

### Algoma Slag Dump Sediment Assessment

Field work, consisting of surficial sediment sampling around the periphery of the site, and biological monitoring with caged mussels to determine the bioavailability of contaminants (i.e. PAHs, metals), was completed in 1989. A final report is scheduled for January 1992, pending availability of analytical results for the mussel tissue samples.

Peter Kauss (416) 323-4952

#### Algoma Slip Sediment Contamination Assessment

Field work was completed in September, 1991. Sediments were collected at 19 stations by diver after preliminary visual inspection, using short core tubes. These were sub-sampled for chemical analysis, benthic community analysis and toxicity testing. Analytical results are expected in late 1991, and a consultant's report interpreting benthic community data relative to sediment quality in March, 1992.

Peter Kauss (416) 323-4952

#### Sault Ste. Marie Wastewater Treatment Plant Evaluation

Two water quality/effluent monitoring/current metering surveys were completed as planned and the chemical data is being compiled. Analysis of the current metering data has not yet been completed.

As a result of the detection of high fecal coliform densities associated with floating material downstream of the WWTP, the collection of surficial sediment samples was added to the second survey. These were submitted for bacterial as well as chemical contaminants analysis. A memorandum discussing the sediment bacterial data was sent to the Sault Ste. Marie, Ontario District Office and the Algoma Health Unit in 1989. Preparation of a preliminary data report is underway. A final report incorporating both water and sediment data is scheduled for April, 1992.

Peter Kauss (416) 323-4952

#### St. Clair River Sediment and Benthic Community Assessment (1990)

Sediment quality (particle size distribution, nutrients, metals, PCBs, organochlorine pesticides, chlorinated aliphatics and aromatics, PAHs, oil and grease) and benthic meio and macro invertebrate sampling was completed at 64 stations in the St. Clair River, with additional emphasis on the upper portion of the river along the Ontario shoreline. Laboratory chemical analyses are almost complete. Enumeration and speciation of the benthic macroinvertebrate samples has been completed through an external consultant.

Biomonitoring with caged mussels for most of the above organic and inorganic contaminants was conducted at ten selected stations in the upper river, and laboratory analyses are nearly complete. Water quality sampling (conventional parameters only) was also performed at these stations and analyses are complete. The first stage of sediment toxicity and bioaccumulation testing (bioassays) using fathead minnows, chironomids and mayfly larvae was completed for sediment samples from thirteen stations, 10 from the upper river.

Aspects to be completed during 1991/1992 include: sediment chemical analyses; consultant's report on benthic macro invertebrate communities and their relationship to sediment quality; sediment metal fractionation analysis (external lab.); and organic fractionation analysis (MOE lab.); contaminants analysis of fathead minnows from the initial sediment toxicity tests; additional toxicity tests using spiked sediments and contaminants analysis of bioassay organism tissues; review and statistical analysis of data.

Peter Kauss (416) 323-4952

#### Talfourd Creek Investigation

In support of the St. Clair River RAP, a detailed investigation of Talfourd Creek was initiated to assess both current and historical contamination and sources in the Creek and the extent of impact on the St. Clair River. The 1989 investigation included coincident sampling for HCB, OCS, dioxins and furans.

Water and sediment (surficial sediments and cores) samples were collected upstream and at the mouth of Talfourd Creek as well as in the St. Clair River; introduced clams were deployed to identify spatial and temporal trends. Except for 1 sample waiting for dioxin analysis, all samples have been analyzed. Data analyses and report preparation are in progress.

Robert Bilyea (416) 323-4962

#### St. Clair River MISA Modelling

A large data base was collected during 1986, in part for model calibration/verification to assess the impact that discharged effluents, from Dow Chemical and Polysar, have upon the St. Clair River. Over the previous 3 fiscal years, both hydrodynamic/dispersion, fate & transport and aquatic food chain models have been developed and applied to examine the impact, and develop effluent loading limits. During 1989/90 a contract extension was granted to allow the development of water quality based effluent loading limits for additional chemicals. The final report including modifications requested by the MOE is expected by the end of March, 1991.

Peter Nettleton (416) 323-4964

#### Development of Spill Assessment Models for the St. Clair System

In 1988, the "St. Clair River Spill Manual" and associated user friendly computer program "SPILLMAN" were developed by Great Lakes Section to assess the travel and plume passage times, and peak concentrations of contaminants spilled into the St. Clair River, upon St. Clair River drinking water intakes. There is a need to expand the current system to include additional spill locations, and assessments for additional drinking water intakes, as requested by the Sarnia District Office.

A modified version of the "SPILLMAN" computer program was completed and sent to the MOE District Office in Sarnia, in July 1990. The collection of field data, namely travel times and current velocities, within the St. Clair Delta, was completed in November 1990. In December 1990, work began on the development of appropriate "post-processing" software, to analyze the two simultaneous data sets obtained from the field work, (ie. from the "Acoustic Doppler Current Profiler", and the "Global Positioning System").

In December 1990, work also began on the development of the "simplified" spill impact assessment model for Lake St. Clair and the Detroit River. This model is specifically looking at potential impacts upon Windsor-Detroit, from a Chemical Valley spill, (most of which enters Lake St. Clair via the South Channel). This work is utilizing actual data from the October 30, 1990 spill of ethylbenzene from Dow. Expected date for completion is December 1991. A preliminary mathematical version of this model has been completed. Work in 1991-92 will involve programming and testing of the model.

Peter Nettleton (416) 323-4964

#### Detroit River Environmental Investigation

A bacterial investigation was conducted in 1988 to determine if any improvements had occurred since 1987 studies, as a result of upgraded treatment at municipal water pollution control plants. Results from the 1987 surveys indicated that Ontario nearshore conditions have not changed significantly since 1984 but have degraded somewhat since 1975.

Coincident with the 1988 bacteriological survey was a study to determine the occurrence of organic contaminants (including PAHs) in Ontario nearshore waters of the Detroit River. This satisfied two needs, including a lack of recent data on the levels of waterborne organic contaminants as well as

addressing more recent concerns of PAH loadings from Ontario point sources highlighted in the UGLCCS point source report.

Sample analysis and data analysis are complete. A final consultant's report was received October 1990, and after correction of some minor errors, publication approvals are currently being sought.

Ron Boone (416) 323-4962

#### Detroit River Hydraulics Measurement Study

This study was carried out to provide field measured dispersion coefficients to enhance the accuracy of spill and general outfall assessments for Ontario sources on the Detroit River. Information on travel times and dispersion coefficients was obtained through the release of a measured, small quantity of tracer solution. On August 9-10, 1990, two releases of 25 kg of dye occurred, i.e. at Little River and at the West Windsor WPCP. Two days were required for fluorometric measurements of the dispersed dye. On August 11, 1990, 76 ambient, whole water samples were collected and submitted to the MOE laboratory for the determination of chloride, nickel and zinc concentrations. Laboratory analyses have been completed. A report is currently under preparation. A report is expected by the end of July 1991.

Ron Boone (416) 323-4962

#### Allied Chemical Plume Tracking

The Upper Great Lakes Connecting Channel Study report (December 1988) identified Ford Canada, West Windsor WPCP and General Chemical (Allied Chemical), Amherstburg as Ontario's major point source dischargers to the Detroit River. An UGLCCS recommendation suggested further examination of the specific impacts of these sources on the Detroit River ecosystem, in particular the benthic region. This study should provide the required information for establishing a cause/effect relationship between a specific point source discharge and an impacted zone.

Conductivity measurements, grab samples (effluent and ambient, whole water - for the August survey), 3-D current velocity profiles as well as depth profiles were collected during the 1990 surveys. Spatiotemporal measurements of vessel position were generated using the Global Positioning System. For the 1990/91 fiscal year, field work and laboratory analyses of both water and effluent samples has been completed; and data editing of the ADCP and GPS files was started. The completion of a draft report is planned for August 1991.

Ron Boone (416) 323-4962

### **2.3 North Channel/Georgian Bay/Lake Huron**

#### Spanish River/Spanish Harbour Suspended Sediment Source

Suspended sediment and water sampling was conducted at the mouth of the Spanish River during the weeks of May 15, July 3, and September 25, 1989 by the Great Lakes Section. A contract for the installation and retrieval of sediment traps was awarded to Integrated Explorations. Traps were installed at three locations in the harbour and Whalesback Channel, with a fourth station near Eagle Island used as a control. The first set of traps were installed in the last week of June and retrieved in the third week of July. The second set of traps were installed in the second week of August and retrieved at the end of September. The third set of traps were installed at the end of September and will be retrieved in the first week of November. All samples were analyzed for metals, PCBs, chlorophenolics and organochlorines. Analyses are outstanding for the September 25 suspended sediment samples and the second set of



sediment traps. A draft report is expected to be completed by April 1991, pending receipt of remaining analytical results.

Duncan Boyd (416) 323-4949

#### Parry Sound Surveillance Baseline Study

At the request of the Northeastern Regional Office, the Great Lakes Section collected data in the 1990 field season on water quality, sediment chemistry, and benthos and plankton composition at a number of stations in the Parry Sound area to document environmental conditions. The results of this study will form a basis for evaluating current and future environmental changes in the area. In-house analysis of water and sediment chemistry, and phytoplankton composition are either completed or in progress. The enumeration of the benthos and zooplankton samples in addition to a statistical evaluation of data from all completed components of the study will be contracted in 1991. A final report is expected in late 1991.

Todd Howell (416) 323-4801

#### Severn Sound Marina Survey

Three active marinas were sampled in 1989 during spring launch, during the August Civic Holiday (August 5-7/89), and during boat winterizing, to assess seasonal changes in volatile, bacterial, nutrient and metal contamination. All field sampling was completed by October 1989. Organotin analysis, under contract with DFO, was received in March 1990. Sediment, clams, water and fish analyses are expected by April 1991. Reporting is to include a summary of findings in the draft Severn Sound Stage 2 report (Oct. 1991) and a RAP technical report expected by Oct. 1991.

Keith Sherman (416) 323-4951

#### Severn Sound Sediment Bioassessment

Recent sediment sampling in the Severn Sound area (1988, 1989) has confirmed that localized areas of elevated bulk sediment concentrations of metals exist. Organic contaminants such as PCBs, DDT and PAHs are present in low concentrations. Six sediment sites were sampled during August 1990. Sediment bioassays are currently underway; the preliminary findings indicate no toxicity at any locations sampled. Final results (toxicity and uptake) are not expected until June 1991. Reporting is to include a summary of findings in the draft Stage 2 RAP document, October 1991.

Keith Sherman (416) 323-4951

#### Severn Sound-Georgian Bay Exchange

The data collected in 1985 for this project was not sufficient to produce a satisfactory water budget and this was attributed to the large grid size and small number of data gathering stations. The study was repeated during the 1988 field season with 18 current instruments and an improved grid configuration. Weekly water quality samples were collected at each current meter location. In addition, two water level recorders were deployed to monitor the fluctuations of water levels. The data analysis and the exchange modelling was completed in September 1990. A section for the RAP report was completed in March 1991. A draft report will be prepared by September 1991.

Balbir Kohli (416) 323-4961

#### Collingwood Harbour Water Quality Survey

Water Samples were collected from spring melt to November 1990 for the analysis of nutrients, metals, trace organics, bacteria and chlorophyll a. A flow-rated sampling regime was followed at the sources. Sampling stations were located at the major inflows, at 4 open water sites within the harbour and at 3 open water sites in Nottawasaga Bay. Wet weather surveys were conducted using a time-sequential sampling regime for bacteria and nutrients. Storm water samples were also submitted for trace organic and inorganic analyses. Data have been provided to an external consultant for modelling purposes. The model generated will be used by the RAP Team for further verification of the expected recovery of water quality based on the preferred options.

Gail Krantzberg (416) 323-4956

#### Collingwood Harbour Mussel Biomonitoring Study

Three stations in the harbour and four stations at the inflows were selected to focus on potentially contaminated sites based on historical activities in the harbour. Duplicate cages containing 8 mussels each were submerged in the harbour for three weeks during the summer on 1990. Mussels were retrieved, shucked, and wrapped in hexane rinsed aluminum foil or "whirlpak" bags for trace organic and inorganic chemical analyses, respectively. Tissues were submitted to the Rexdale laboratory for sample preparation and analysis. Sediment was collected concurrent with mussel retrieval and submitted to the laboratory for trace organic and inorganic analyses. Lab analysis is expected to be completed by September 1991, at which time a data report will be prepared in support of the RAP.

Gail Krantzberg (416) 323-4956

#### Collingwood Harbour Sediment Cores and Bioassessment

Cores were collected at five stations in proximity to the CDF, at five stations along a transect from the shipyard's (CSL) slips, at three stations in the harbour and at one station in Nottawasaga Bay. The cores were sectioned and analyzed for trace metals. Sediment for bioassays were collected by Ponar grab. The surficial 5 cm were removed for the assays in addition to bulk sediment homogenized from the entire contents of the Ponar. Intact cores were collected for sediment bioassays for comparison with bulk and surficial sediment bioassays. Growth, mortality, and bioaccumulation were the endpoints measured in juvenile fathead minnows (*Pimephales promelas*) and nymphs of the mayfly *Hexagenia limbata*. A report was released in October 1990 with the findings of the study. Sediment from the shipyards is contained within the property and is not having an impact on harbour quality. No adverse biological effects of sediment from Collingwood Harbour were detected. Surficial sediment has lower concentrations of some metals than deeper sediment as a result of the removal of active sources of contamination.

Gail Krantzberg (416) 323-4956

#### Collingwood Harbour/Nottawasaga Bay Modelling

An acoustic doppler current profiler, and other current instruments, were installed in the shipping channel and in Nottawasaga Bay in August 1989 and operated until November 1989. The information obtained will be used in an excursion-episodal model to obtain a better resolution of the channel dynamics and therefore estimate of the exchange and water budget for the harbour. The data processing and modelling will be conducted by a consultant and is expected to be completed by December 1991. Additional field data collection may be necessary, depending on the quality of the 1989 data.

Balbir Kohli (416) 323-4961

## 2.4 Lake Erie

### Lake Erie Harbours Synoptic Survey

Sampling for water and sediment quality analyses and benthic enumeration was completed at Leamington, Kingsville, Colchester, Sturgeon Creek, Port Stanley, Port Bruce, Port Burwell, Maitland and Port Colbourne during 1988 and 1989. Samples were analysed for physical parameters, bacteria, nutrients, trace metals, PCBs, organochlorine pesticides, triazine herbicides, and PAHs. Laboratory analyses have been completed for all 1988 and 1989 samples. The complete data file will be summarized for comparison with PWQO, sediment quality guidelines (when available), and spatial comparison to establish relative conditions across all locations (ANOVA, PCA). This work will be completed with the assistance of a fee-for-service contract which commenced in March 1991.

Robert Bilyea (416) 323-4947

## 2.5 Niagara River

### Niagara River Toxics Management Plan Participation

Great Lakes Section staff participated on the Data Interpretation Group of the River Monitoring Committee. The group produced a final report in November 1990 entitled "Joint Evaluation of Upstream/Downstream Niagara River Monitoring Data for the Period April 1988 to March 1989".

Mary Kirby (416) 323-4957

### Niagara River Caged Mussels and Leeches

Twenty-nine sites located near major dischargers or tributaries on both sides of the river were examined in 1987 for contaminant levels in caged mussels and leeches. Sediments and Cladophora were also collected where possible. Laboratory analysis and data tabulation were undertaken in the 1988/89 fiscal year. Preliminary results were summarized and released on May 31, 1988. High levels of PCBs, Mirex and dioxins were found on the U.S. side of the river. Levels of 2,3,7,8-TCDD found in the Pettit Flume mussels were 10 times higher than in 1985. A draft report on the 1987 study was completed in March 1990 and is presently being finalized for release.

As an update study to the 1987 investigation of Niagara River sources, fifteen sites were re-examined for contaminant levels in caged mussels and leeches during 1989. Sediments were also collected where possible. The mussels and leeches were exposed in the Niagara River near major dischargers on both sides of the river and at the upstream and downstream long term monitoring stations in July of 1989 for 3 weeks. Laboratory analysis has not been completed to date. A report presenting the findings is planned upon receipt of the laboratory analysis. Twenty-five stations will be examined for a range of contaminants in 1991.

Lisa Richman (416) 323-4953

## 2.6 Lake Ontario

### Lake Ontario Toxics Management Plan Participation

Section staff contributed to the ongoing management and delivery of the four-party Lake Ontario Toxics Management Plan (LOTMP) through participation on the Lake Ontario Secretariat, the Fate of Toxics

Committee and the Binational Ecosystem Objectives Workgroup.

In 1990/91, the draft status report and plan update to the LOTMP was prepared and reviewed at public workshops in December 1990 at Hamilton, Ontario and Rochester, N.Y. The final status report and update is expected to be released in the fall of 1991. LOTMP committee investigations completed during 1990/91 include: documentation of static and dynamic models of the fate and transport of selected toxic substances in Lake Ontario (Fate of Toxics Committee); evaluation of standards and criteria applicable to Lake Ontario (Standards and Criteria Committee); and development of ecosystem objectives for the lake (Ecosystem Objectives Workgroup).

Section staff also contributed data and scientific services to a contract assessment of lakewide impaired uses being undertaken by Environment Canada as a precursor to a Lakewide Management Plan for Lake Ontario.

Tom Coape-Arnold (416) 323-4943

#### Lake Ontario Benthos-Sediments Integration

This study involves the statistical analysis of benthos, sediment-chemistry and sediment particle-size data from 4 depths on 25 transects from along the Canadian shore of Lake Ontario. A comparison of co-varying patterns between matrices summarizing trends in sediment chemistry, particle size and the benthic community is ongoing. Analyses to factor or partial-out one pattern from another are underway. A draft report summarizing these methods and associated findings is in progress. In addition, a follow-up survey is planned for 1991. Terms of reference for that study are being drafted.

Keith Somers (705) 766-2412

#### St. Catharines Nearshore Circulation

The RAND modelling was successfully completed to assess the bacterial impact of 12-Mile Creek and the Welland Canal. The model was calibrated using the August 1986 data set, and then calibrated with the September 1986 data set. The modelling illustrated that the beaches are usually contaminated during a rain event and remain contaminated for up to 24 hours after the rain ends. Sources of pollution at the beaches have been identified and levels of reductions in loadings have been recommended for the opening of the beaches. The City of St. Catharines has requested that MOE assess some additional scenarios, i.e. the impact of the storm sewer discharge from an offshore diffuser, and this was completed in September 1989. A draft scientific report was completed in December 1989. The final report was completed in May 1990.

Balbir Kohli (416) 323-4961

#### Hamilton Harbour Sediment Mass Balance Study

Results of 1988 centrifuging at major inputs to the harbour and at the Burlington Ship Canal have been summarized and will be combined with relevant flow data to provide improved loading estimates for suspended sediment and associated contaminants. Existing hydrodynamic data, modelling capabilities, and sedimentation estimates will also be assessed in order to clarify additional data collection requirements for the application of a chemical fate and transport model such as TOXIWASP. The initial product will be an annual sediment budget summary and recommendations for the development of the detailed model and this is anticipated during early 1991. Results of 1990 centrifuging will be incorporated as they become available (i.e. late 1991).

Duncan Boyd (416) 323-4949



#### Hamilton Harbour Sediment Load Bioassessment

Six of eight planned Centrifuge sampling episodes at tributaries, STPs, and industrial discharges have been completed. Whole water and suspended sediment samples are being analyzed for physical parameters, nutrients, trace metals, organochlorines, chlorobenzenes, and PAHs. Once these results are available (expected by summer of 1991), they will be incorporated with the 1988 results and used to update the sediment mass balance. Due to the failure to secure additional external funding, the sediment trap sampling and suspended sediment bioassay components of the study could not be undertaken this field season. The associated laboratory resources have been reallocated to an expanded St. Lawrence River study. The sediment trap sampling component has been proposed for 1991.

Duncan Boyd (416) 323-4949

#### Hamilton Harbour Sediment Bioassessment

Trace metals in a substantial portion of the sediment in Hamilton Harbour exceed the provincial draft sediment guidelines which identify the "severe effects level". Due to the large volume of contaminated sediment in the harbour, it may be prohibitively costly and technologically impractical to recommend immediate dredging and disposal of all sediment that exceed the SEL. Several studies were designed to help prioritize areas for clean up by establishing the degree to which contaminants in the harbour are biologically available, comparing the biological response of test organisms exposed to harbour sediment with weak acid extractions of metals from that sediment, relating toxicity observed in bioassays to sediment treatments and to the oxygen regime in overlying water which varied depending upon sampling date, and by evaluating tissue residues of contaminants in test organisms in light of sediment contamination and extractable metal concentrations.

The results of chronic, solid phase bioassays using treated and untreated sediment revealed that some areas of the harbour are toxic and that the sediment treatments were effective in reducing toxicity to mayflies and fathead minnows in some instances. The substances used to treat the sediment are known to chelate metals, and this assists in identifying the source or cause of the toxicity. There was, however, evidence that sediment oxygen demand resulted in mortality and impaired growth of the bioassay organisms; mayflies, chironomids and fathead minnows. One of the most apparent causes for the restricted benthic community observed in the harbour is the anoxia which develops in the hypolimnion during the summer months. Further bioassessment of incoming particulate matter will take place in the summer of 1991 and will assist the RAP Team in establishing targets for sediment restoration.

Gail Krantzberg (416) 323-4956

#### Hamilton Harbour Bacteria Survey

A bacteria survey was conducted in 1990 to provide assistance to the Hamilton Harbour RAP by identifying whether those zones identified as potential swimming sites in the Harbour meet bacteriological health requirements. Swimming has been identified in the RAP as one of the beneficial uses to be restored in the Hamilton Harbour Area of Concern. Twelve stations in the harbour were sampled three times a week during five weeks over the period from mid-July to late August. Sample results have been received for fecal coliforms, *Pseudomonas aeruginosa*, and *E. coli* (at two stations) and a summary has been provided to the Hamilton Harbour RAP Team. A more detailed report was prepared in consultation with the municipal Health Units in early 1991 and was made available as a support document for the Hamilton RAP.

Duncan Boyd (416) 323-4949

#### Toronto Waterfront Dry Weather Outfall Study

A consultant's draft report presenting dry weather contaminant loadings from storm sewers, combined sewer overflows, sewage treatment plants and water filtration plant backwash water has been reviewed by MOE. Revisions are being made for resubmission and review by municipal agencies. The report provides an assessment of the relative annual and seasonal loadings from the various sources to the waterfront under dry weather conditions.

In 1989, clams were introduced in cages for a period of 21 days at 23 locations across the Metropolitan Toronto Waterfront. These locations included tributaries, sewage treatment plant effluent (prechlorination) and priority outfall locations identified in a 1988 dry weather outfall study. The clam tissues were submitted for the analysis of PCBs, organochlorine pesticides, chlorobenzenes, PAHs and metals. The analyses of these samples has not been completed. This data will be used with data from the dry weather outfall study to provide a baseline for the development and assessment of remedial measures and to identify outfalls requiring more detailed investigations.

Michael D'Andrea (416) 323-4960

#### Toronto Waterfront Wet Weather Outfall Study

A contract for the development of an urban runoff prediction model for storm sewers and combined sewer overflows discharging along the City of Toronto waterfront was awarded in September, 1990. The field work component of this study which involves the collection of flow weighted composite samples and flow data from selected test catchment and outfall locations during runoff conditions began in September and has now been completed. Analytical data for the samples collected is being received and the analysis is expected to be completed by April 1991. Model development is expected to begin once all the data has been received.

A contract for the analysis of large volume (16 litre) samples collected as part of the field program was awarded in September, 1990. The samples will be analyzed for trace organics including PCBs, organochlorine pesticides, chlorobenzenes and PAHs. The first set of samples were submitted for analysis in late September. Analyses of all samples collected is proceeding.

Michael D'Andrea (416) 323-4960

#### Assessment of Tributary Loadings to the Metro Toronto Waterfront

In developing the Toronto Waterfront RAP, the RAP Team has recognized a deficiency in data for various contaminant inputs to the waterfront including the tributaries. A recent study (Dry Weather Outfall Study) recognized that the tributaries contribute approximately 50% of the total annual flow to the waterfront. Little data, however, is available to evaluate their relative contribution of trace organics.

Previous studies have been limited in scope and have concentrated primarily on conventional pollutants.

The study will develop an improved data base for the assessment of contaminant loadings from six tributaries: Rouge River, Highland Creek, Don River, Humber River, Mimico Creek and Etobicoke Creek. This will involve increased sampling frequency and the collection of large volume samples for the analysis of trace organics.

To date, monitoring stations have been established at the Don and Humber Rivers and at the Mimico and Etobicoke Creeks, as close to the mouth as possible, upstream of lake backwater effects. An automatic sampler is used to collect 24 hour, 120 litre composite samples. A 100 litre subsample is used for the analysis of trace organics (PCBs, organochlorine pesticides, chlorobenzenes and PAHs).

Sampling was initiated in November 1990, and collections are made both under dry and wet weather conditions. Samples have been submitted for analysis and analytical results are being received. Sampling stations at Highland Creek and the Rouge River are expected to be established by July 1991.

Michael D'Andrea (416) 323-4956

#### Toronto Waterfront Sediment Survey

During 1989, four cruises were conducted in support of this program. Samples were submitted to the MOE laboratory for analysis of general chemistry, heavy metals, organics and particle size. Laboratory analyses of sediment samples were completed in January 1991. A data report synthesizing the results should be completed by summer 1991.

In addition, the sediments were mapped by an external consultant using an electromagnetic conductivity survey technique. The final report on mapping of sediments in four areas of the waterfront (two of which are impacted by STP inputs, and two of which are impacted by lakefilling) has been received. The study determined the spatial distribution of contaminated soft material in the surficial sediments of each area, as well as their seasonal variation and estimates of the relative depth of contaminated sediments. Operational difficulties and means of improvement of the technique were included.

Don Poulton (416) 323-4954

#### Toronto Harbour Exchange

For the management of the harbour loadings of water quality parameters, it is essential to understand the exchange of water between the harbour and the lake through the two gaps connecting Toronto Harbour and Lake Ontario. Such a knowledge will be useful for the RAP Team to assess the assimilative capacity of the inner harbour for contaminant loadings from the Don River and combined sewer overflows. The modelling results will also be used to obtain a water mass budget and nutrient mass budget of the harbour.

Acoustic Flowmeters (AF), Acoustic Doppler Current Profiler (ADCP) and Recording Current Meters (RCM) will be deployed in the two gaps from June 1991 to May 1992 to estimate the exchange for an entire year, covering all seasons.

It is expected that a contract for the purchase of the acoustic flowmeters, deployment, installation and data analysis from all instruments, will be awarded by May 1991. Installation will be from June 1991 to June 1992, and data analysis and final reporting will be complete by March 1993.

Balbir Kohli (416) 323-4961

#### Port Hope Sediment Bioassessment

Sampling was completed at five stations throughout the Turning Basin, West Slip, and lower Ganaraska River in May 1990. The original plan called for subacute/chronic sediment bioassays (i.e. growth and survival) to be performed by WMS of MOE using mayflies or chironomids and juvenile fathead minnows. Concerns about the potential health hazard associated with handling low level radioactive waste has resulted in the need for screening by the Ministry of Labour, Radiation Protection Branch and analysis for radionuclides prior to proceeding with the sediment bioassays. This expansion in the scope of the original survey has resulted in the need to eliminate the second sampling period scheduled for the fall of 1990. Radiological analysis is expected to be undertaken in late 1990, and if permissible, bioassays will be undertaken in 1991 as part of an external lab contract for the 1991 sampling program.

Duncan Boyd (416) 323-4949

### Bay of Quinte Toxic Contaminants Study

The final version of the technical report on 1988 water, effluent and sediment sampling has been completed and released for public and PAC use. Results show that water quality in the Bay is acceptable with regard to most metals, as well as organic contaminants except phenols. However, sediments continue to be contaminated with deep-water sediment heavy metal levels generally exceeding dredge spoil disposal guidelines, and appreciable contaminant levels continue to occur in most biota. The major point sources of most contaminants are the Belleville STP for heavy metals, and Domtar Wood Preserving for organics such as pentachlorophenol. Sources for PCBs and several metals such as cadmium and lead could not be defined due to inadequate detection limits.

Don Poulton (416) 323-4954

### Cataraqui Bay Survey

This project was carried out in Cataraqui Bay and Parrots Bay in the vicinity of DuPont and Celenese industries. Electromagnetic conductivity of sediments was completed and effluents were sampled in 1989. In fall 1990, the final consultants report on the electromagnetic conductivity of sediments was received. Sediment and benthic invertebrate sampling was completed the end of September 1989. Subsequent chemical analysis is not expected to be available until late 1990. A contract to enumerate and statistically summarize patterns in the benthos is underway. A draft report is expected in the near future.

Don Poulton (416) 323-4954

## **2.7 St. Lawrence River**

### St. Lawrence River Bacteriological Assessment 1990/91

Beaches along the St. Lawrence River at Cornwall have closed due to fecal coliform levels in excess of the current Provincial Water Quality Objectives for body contact recreation.

The objective of this survey was to assess the water quality to determine future remedial actions to control bacterial contamination. *Klebsiella* was also monitored to assess its component in the fecal coliform count. Since a large component of the fecal coliform count may not be organisms that are a health concern (such as *Klebsiella*), there is a need to develop new Water Quality Objectives using indicator organisms such as *Escherichia coli* and *Pseudomonas aeruginosa*.

Water and effluent samples were collected from municipal and industrial point sources and in the nearshore area of the St. Lawrence River. Fecal coliform densities were typically less than 10 organisms/100ml for mainstream St. Lawrence River water. Several nearshore areas repeatedly exceeded the Provincial Water Quality Objectives and *Klebsiella* was routinely detected downstream of Domtar as far as South Lancaster.

Since 1980, there have been no improvements in the bacterial quality of the river even though there has been a reduction in combined sewer overflows from the Pitt St. and Amelia St. sewers and the Sewage Treatment Plant has been upgraded. The St. Regis Sewage Treatment Plant remains a problem and private septic inputs along Lake St. Francis need to be considered as uncontrolled sources.

Lisa Richman (416) 323-4953



#### St. Lawrence River Sediment and Biological Assessment 1990

The Cornwall Sediment Remediation Study has been modified since it was originally proposed. Initially, we planned to delineate the area of sediment contamination (metals, organics etc.) and attempt to quantify the volume of contaminated sediment which requires remediation. This study is planned for the future. Presently, the RAP team has decided to focus on mercury, a contaminant of primary concern. There are consumption restrictions on some sport fish due to mercury contamination and areas exist with highly contaminated sediment. The objective of the study is to determine the relative importance of the sediment as a source of mercury to the St. Lawrence River and biota. Since there are several sources of mercury to the AOC, it is essential to determine their relative contribution of mercury so that priorities for remedial options can be set.

A contract for the collection of sediment and benthos from 18 stations has been issued to Integrated Explorations. Samples will be collected in March 1991. Sediment, water and benthos will be analysed for methyl mercury, the most bioavailable form of mercury. A contract has been issued to Brooks Rand Ltd. to analyze the sediment samples. Sediment bioassessments are planned for the spring using mayfly nymphs or *Chironomus* and/or fathead minnows.

Lisa Richman (416) 323-4953

#### St. Lawrence River Hydraulic Measurements Study

Additional information regarding the complicated hydraulic characteristics of the St. Lawrence River near Cornwall was collected in 1990 to provide more accurate predictions of the dispersion, transport and fate of discharged toxic contaminants from Cornwall area point sources. These results will be of importance when considering remedial options for the St. Lawrence River RAP. A final report is expected by August 1991.

Peter Nettleton (416) 323-4964

#### Cornwall Hydraulics (ACDP) Study

The purpose of this study is to collect information regarding the complicated hydraulic characteristics of the St. Lawrence River near Cornwall, using the "Acoustic Doppler Current Profiler" (ADCP). This information will be used to provide more accurate predictions of the dispersion, transport and fate of discharged toxic contaminants from Cornwall area point sources. A secondary purpose of this project is to initiate use of the ADCP under a "vessel mounted" (ie. moving boat) mode of operation.

Field measurements were taken during August and November in 1990. These included the use of the vessel-mounted ADCP, Global Positioning System (GPS), and depth soundings, simultaneously. These measurements were taken at 23 transects across all channels in the Cornwall Island-St. Regis Island portion of the river.

Between December 1990 and March 1991, the GLS examined the quality and nature of the collected data sets, in order to design appropriate software, to permit integration and analysis of the ADCP, GPS and depth data sets, simultaneously. Appropriate software is required since there was a tremendous amount of data collected, (ie. several megabytes), because of the high frequency of measurements taken during a "vessel mounted" mode of operation. The design details for three initial software programs have been identified, which will permit calculation of depth-averaged and depth-specific velocities, and channel discharges.

During 1991-92, the data analysis software development will be completed via a computer programming service contract. Then, appropriate segments of the data will be analyzed, and the results summarized

within the "St. Lawrence River Hydraulic Measurements Study" Report.

Peter Nettleton (416) 323-4964

#### Cornwall MISA Modelling

As part of the MISA pilot site program, models were developed to determine the impact of discharged Cornwall effluents upon the St. Lawrence River. Current meter data was collected from the St. Lawrence River at Cornwall during 1988. This data has been used to calibrate hydrodynamic models applied over the past 2 fiscal years. Chemical data from 1979 and 1985 was used during 1989/90 to calibrate steady state chemical transport, sediment fate and aquatic food chain models. A 'first draft' of each model has been written. The final report should be completed by July 1991. The models will be used to develop water quality based effluent loading limits for key chemicals discharged from selected industries, and the Cornwall WPCP.

Peter Nettleton (416) 323-4964

## **2.8 Contingency Responses**

#### Owen Sound Investigations

In April 1990, an oily sheen observed in Owen Sound Harbour near the Goodyear V-Belt Plant led to sampling of the plant's effluent by local Ministry staff. Although initially identified as polychlorinated biphenyls (PCBs), subsequent analyses showed that the contaminant was in fact polychlorinated naphthalenes (PCNs).

Available information indicated that some PCNs are strong irritants, have the potential to accumulate in organisms and persist in the environment, and are toxic to certain marine test organisms. There were, however, no available criteria or objectives for PCNs, nor any information on the effects on freshwater species from which such values could be derived for the Province of Ontario.

Consequently, a survey was conducted from October 16-19 by Great Lakes Section to assess the environmental impacts of the Goodyear discharge on nearby Owen Sound Harbour water, sediment and biota.

Total PCNs in the Goodyear final effluent were less than the 20 ng/L MOE detection limit following the installation of carbon filtration and an adsorbent boom at the outfall. A large volume sample produced 13 ng/L (detection limit 10 ng/L). PCNs appear not to be accumulating significantly in the immediate environment in Owen Sound Harbour despite potential to do so. No PCNs were detected in the water or the sediment in four transects into the Harbour.

#### Emergency spill impact assessments, for the protection of municipal drinking water intakes

##### i) Spill of Vinyl Chloride Monomer (VCM), from Esso Chemical Ltd. on July 20, 1990:

On July 20, 1990 an emergency request was issued by The Spills Action Centre asking for verification of calculations performed by the Sarnia District Office, using the GLS "SPILLMAN" computer program. The amount of VCM released was assumed to be between 55 and 12 kg, as estimated via two possible loading scenarios.

The analysis confirmed that peak concentrations at the Walpole Island and Wallaceburg drinking water intakes would exceed the long-term drinking water criterion of 2 ppb. Also, the length of

time that this criterion would likely be exceeded was estimated to be around 6 hours.

ii) Spill of ethylbenzene from Dow Chemical on October 29-30, 1990:

The Spills Action Centre contacted the office on October 30th, and asked to verify calculations performed by the Sarnia District Office for the Walpole Island and Wallaceburg intakes. Also, the Great Lakes Section was asked to estimate peak concentrations at the Mitchell's Bay and Windsor intakes, which required the derivation and application of appropriate assessment techniques.

The amount of ethylbenzene released was estimated at 400 kg, (which was updated later in the day to 1800 kg). The estimated peak concentrations, and their times of occurrence were estimated and provided to the Sarnia Office the same day. They indicated that violation of the taste and odour limit of 2.4 ppb would occur at Walpole Island and Wallaceburg, and likely occur at Mitchell's Bay and Windsor under "worse case" conditions.

Peter Nettleton (416) 323-4964

Post-spill assessments in support of possible litigations

Spill of Diethylbenzene (DEB) from Polysar on October 18, 1989:

Assistance was requested by the Investigation & Enforcement Branch to estimate spill loadings and concentrations within the St. Clair River, for the October 18, 1989 spill event. This information was to be used in possible litigation against Polysar.

An in-depth analysis was necessary, since only limited loading and downstream measured data were available. This involved the application of three models and three possible loading scenarios. The overall conclusions were that the amount of DEB discharged was between 100 and 300 kg, and that concentrations in the St. Clair River ranged from 20 to 29 ppm just downstream of the outfall.

Peter Nettleton (416) 323-4964

Spill Exercises

"CANUSLAK - 1990" was a large scale, spill exercise conducted during September 10-13, 1990. The major purpose of the exercise was to evaluate the "Joint Canada/United States Marine Pollution Contingency Plan and Great Lakes Annex" through response to a simulated spill. As such, it involved several local, provincial-state, and federal agencies, including the MOE.

The Great Lakes Section was requested via the Sarnia District Office of the MOE to participate, by providing predicted spill impact assessments. The exercise involved a simulated ship collision within the St. Clair River. Large quantities of No. 6 Fuel Oil, acetic acid and ammonium-thio-sulphate were spilled into the river. The exact locations where these materials entered the St. Clair River had not been previously modelled. Appropriate simulation models were adapted and deployed to provide the Sarnia Office with estimated concentrations at the downstream drinking water intakes on both the Ontario and Michigan sides of the river.

In an overall performance assessment made after the exercise, the Great Lakes Section modelling contribution was deemed to be successful.

Peter Nettleton (416) 323-4964

## Outfall assessments and reports for Regions

During the fiscal year, the Section was requested by MOE Regional personnel to assist in the following projects:

- i) Port Dover outfall modifications (a capacity increase of an existing outfall),
- ii) Sunlake resorts outfall (a new outfall),
- iii) Etobicoke Motel Strip Development (a proposed development).

For the first two projects, engineering consultants were provided with appropriate dilution-modelling technology and instructions. Reviews and recommendations were provided for modifications to the proposed outfalls to prevent adverse water quality impacts. Reviews of the report for the third project, resulted in recommendations for appropriate changes to the modelling exercises to allow for proper assessment of the impact of new developments on local water quality.

Balbir Kohli (416) 323-4961

## **2.9 Basin-wide Projects**

### Long Term Sensing Sites

This program was established in the fall of 1988 to examine temporal and spatial variability in water, sediments and benthos at a network of stations throughout the Great Lakes. Five stations were surveyed once in late 1988. These same stations were surveyed monthly from May through November in 1989. In 1990, the 5 Niagara stations and 10 Lake Ontario stations were sampled in the spring, summer and fall. The 1989 survey produced 175 samples of water, sediments and benthos. The majority of these lab results have been received and are being tabulated. The 1990 survey produced 225 samples of water, sediments and benthos. In addition, 144 samples of clam biomonitors were deployed and retrieved. All the 1990 samples have been collected and submitted to the MOE Rexdale lab. All water analyses are now complete, sediment and biomonitor analyses are ongoing. An external contract has been initiated to sort and identify the benthos from the 225 samples. Planning for the 1991 survey of the 5 Niagara stations and 10 Lake Huron stations is ongoing.

Todd Howell (416) 323-4801

### Sediment Metals Bioavailability Study at Areas of Concern

Sediment was collected from sites selected to span a range of metal concentrations and toxicity. Benthic invertebrates were also retrieved for analysis of metal residues. For each station, aliquots of sieved sediment were extracted using weak leaching agents to estimate metal bioavailability. Sediment was also subjected to the MOE standard protocol for bulk chemistry, organic content, and particle size. *In situ* biota were analyzed whole, and with guts cleared. Twenty-one day static sediment bioassays were conducted using mayfly nymphs and juvenile fathead minnows. Growth, mortality, and bioaccumulation of trace metals were recorded. A 10 day chironomid growth and survival test using 2nd instar Chironomus was also conducted. Spatial variation in these observations will be compared with the spatial variation in extractable metal concentrations and tissue residues in native infauna. A multivariate statistical approach will be used to relate sediment chemistry to metals in biota and to bioassay results. Where chemical parameters explain a large portion of the variability in biotic responses, this information will be used to predict the environmental significance of trace metals in the sediment of Areas of Concern not used in the study. Laboratory analysis is anticipated to be completed by spring 1991. This is the first year of a multiyear project.

Gail Krantzberg (416) 323-4956



#### Great Lakes Tributary Mouth Biomonitoring

Twenty tributaries to Lake Ontario were sampled to estimate contaminant inputs through the deployment of mussel biomonitors and fall collections of small fish in 1989. Twenty-two samples of clams were submitted for these Lake Ontario sites. Approximately 50 small fish samples were also submitted. Most of the results of these analyses have been received. In 1990, 21 samples of clam biomonitors were submitted from tributaries to Lake Huron. In September, small fish were collected from the lake near each tributary mouth and upstream within the tributary by an external contractor. A final report that summarizes this collection has been received. The resultant 42 samples of small fish were submitted to the MOE Rexdale Lab. Chemical analysis of these 1990 samples is in progress.

Todd Howell (416) 323-4801

#### Remedial Action Plan Program Participation/Coordination

The Province of Ontario has twelve Areas of Concern on the Great Lakes proper and an additional five on connecting channels which it shares with the states of Michigan and New York. The RAPs are being developed under the direction of a RAP Steering Committee and 17 RAP Teams composed of representatives of provincial and federal agencies responsible for Great Lakes programs. The Ministry of the Environment has provided annual enhanced funding for RAP development of approximately \$2.1 million per year. The provincial program is coordinated and administered through Great Lakes Section.

In support of the development of Remedial Action Plans, the Section has conducted a number of field studies to update knowledge of environmental conditions, and to identify associated impaired uses and pollution sources for the completion of Stage 1 reports for the 17 Canadian Areas of Concern. Assessments, such as sediment and benthic surveys and sediment bioassays, are conducted to provide necessary information on biological impacts before recommendations for remedial measures can be made. Other sampling programs are carried out in order to establish cause-effect relations, to develop appropriate remedial options and surveillance plans for implementation and to track the effectiveness of remedial measures.

In addition to conducting technical studies, the Section has participation on each of the 17 Canadian RAP Teams. Of these, Severn Sound and Collingwood Harbour RAPs are coordinated within the Section. RAP Team members provided assistance in the finalization of the Stage 1 reports, participated in public meetings, and for the more advanced RAPs, provided general technical support in the assessment of remedial options for the Stage 2 report.

The current program schedule shows completion of the 17 RAPs by the end of 1992. Remedial options are to be developed and evaluated to address restoration of impaired uses related to recreation, water supply and aquatic life. To date, remedial options have been developed for the Bay of Quinte, Severn Sound, Collingwood, Metro Toronto, and Hamilton Harbour Areas of Concern. Others have completed problem definition and are proceeding to develop remedial options.

Tom Coape-Arnold (416) 323-4943

#### Zebra Mussel Initiatives

On June 1, 1988 researchers at the University of Windsor found zebra mussels in southeastern Lake St. Clair. Zebra mussels were likely introduced through ballast-water discharge from a ship that had recently visited Europe. In 1989 zebra mussels dispersed from Lake St. Clair, throughout Lake Erie, the Niagara River and the Welland Canal into western Lake Ontario. Great Lakes Section initiated a report to survey and summarize scientific literature on the ecology and control of zebra mussels. Over 1800 copies of this report have been distributed. Great Lakes Section staff also serve as a liaison on a three-year research contract to study the ecology and possible control strategies of the zebra mussel in the Great Lakes.

In early January 1990, the Ministry of Natural Resources agreed to be the lead agency and coordinate a provincial government program to deal with zebra mussels. Great Lakes staff worked on this Ad Hoc Interministerial Coordinating Committee and assisted with the preparation of a Cabinet Submission for additional funds to address the zebra mussel problem. Great Lakes staff also worked with Hazardous Contaminants Branch and Approvals Branch to prepare guidelines for applying for Certificates of Approval for the modification of water and sewage works to control zebra mussels. This short-term control strategy involves chlorination through the use of chlorine gas or sodium hypochlorite. Ontario Hydro is conducting research to identify long-term solutions to zebra mussel control at water intakes. In addition, the Great Lakes Section has established a Zebra Mussel Initiatives Working Group with representation from the Operations, Approvals and Engineering, and Environmental Services Divisions to coordinate activities and resolve emerging issues with respect to zebra mussels. This group will concentrate on impacts on water intakes, contaminant dynamics and associated water quality impacts.

Fred Fleischer (416) 323-4958

#### Ontario Hydro Liaison Activities

This is an ongoing activity. Current concerns include the Nanticoke Tempering Exemption Study and Fish Impingement Committee Report. Draft reports have been completed and are under review. Participants on these projects include representatives from Ontario Hydro, MOE, MNR and DFO.

Mary Kirby (416) 323-4957

## **2.10 Methods Development/Systems Support Activities**

#### Point Source Impact Zone Assessment

Geographic information systems are now accepted as state-of-the-art graphical presentations of geographically referenced data. Statistical methods to compare and evaluate the significance of similarities or differences between thematic overlays are in their infancy. To date a number of simulations and test data sets have been used to evaluate the utility of spatial analysis methods commonly used in geology. Recent efforts have focused on the development of methods to partial or factor-out one influence (or theme) to reveal underlying patterns that are masked or confounded. Trial analyses using a variety of simulated patterns are complete. Field data on sediments and benthos from Jackfish Bay will be examined to assess the zone of influence of the point-source discharge at the head of the bay.

Keith Somers (705) 766-2412

#### Great Lakes Outfall Screening Assessment

Two draft documents regarding general procedures involved in assessing the impact from outfalls to the Great Lakes and connecting channels were developed during 1989/90. A "Request For Proposal" to update near field mixing assessment procedures in the Connecting Channels of the Great Lakes, was completed in December 1990. Proposals were received from three potential contractors in March 1991, and will be reviewed to select a contractor in April, 1991. These procedures will be used to identify and delineate potentially significant point source impact zones from all the major outfalls discharging from Ontario to the Great Lakes. This contract will likely not be completed until June 1991.

Peter Nettleton (416) 323-4964

### Outfall Assessment Modelling

MOE is committed to developing guidelines for point source impact zones in the Great Lakes. The basic policy and guidelines are provided by the MOE Blue Book and related Environmental Assessment Act. However, the detailed techniques and procedures to accomplish this are not well defined or require updating to meet new demands for consistent province-wide application. In order to assess point source impact zones in the Great Lakes, there is a need to develop a modelling package to undertake the following, including plotting:

- a) design alternating, staged and unidirectional diffusers
- b) perform stability analysis
- c) assess initial dilution for different types of discharges
- d) assess far-field dilution

A literature search has been initiated to obtain the latest methods, including the ones developed by US EPA and MOE. These should be combined in a user friendly software for IBM PC or compatible. Such models should provide assessment of many scenarios for outfalls, under different lake conditions, suitable for delineation of point source impact zones. These models will be useful for the regional offices of the MOE and consultants in the province.

Balbir Kohli (416) 323-4961

### Rand Model Development

The Rand model was developed by Rand Corp., Santa Monica, CA. The model was modified by a consultant under contract to MOE, so that it could be used for up to three open boundaries in the nearshore regions of the Great Lakes. The model has been used at Toronto Waterfront and St. Catharines Waterfront to predict the hydrodynamics and water quality due to multiple source discharges. The model has been modified so that it can run with a refined grid size for better resolution. This will provide more confidence in the model. In addition, the graphics package has been enhanced. The efficiency of the modelling has been increased 2-3 fold. This project will be ongoing to continually develop and update the model and improve its usage.

Balbir Kohli (416) 323-4961

### Assembly of Modelling Transformation Parameters for Inplace Contaminants

Fate and Transport and Food Chain Models have recently been developed to evaluate the impact of contaminant loadings to the aquatic ecosystem. Within the Great Lakes Basin, concerns have been identified regarding In-place pollutants. Questions related to the toxicity of such contaminants to both benthic organisms (in particular) as well as other aquatic organisms at higher trophic levels have been raised. In order to reach a scientifically acceptable solution to the various problems posed by In-place pollutants, a clear understanding of the dynamics and fate of these contaminants is mandatory.

The assembly of the significant modelling transformation parameters is the essential first step in answering such questions. For the 1990/91 fiscal year numerous pertinent references will be reviewed. Selected MOE and external scientists will be consulted in order to assemble relevant data. This data will be loaded into a computer data base. It is anticipated that data analyses will be completed by December 1991.

Ron Boone (416) 323-4962

#### Great Lakes Fate and Transport Modelling

MOE's regulatory activities have largely focused upon 'near source' impact, when deriving effluent criteria for outfalls. The long-term, long-distance impact of toxic chemical discharges, particularly combined with land and atmospheric sources, has not been adequately addressed. Large scale fate and transport models will be developed to investigate the movement and transfer of toxic chemicals among the water, land, and air, and their impact upon the aquatic food chain, of selected water bodies of the Great Lakes. These models will provide a general framework for evaluating the relative importance of sources, at different locations, and therefore indicate appropriate means of toxic load reductions. Adaptation of the mass budget model is dependant upon computer system upgrades, which have been ordered, but not yet received.

Peter Nettleton (416) 323-4964

#### Pharmacokinetic Modelling

Physiologically based pharmacokinetic models (PB-PK models) use the anatomically defined characteristics of organs to estimate the molecular dose of chemical reaching a particular organ during a certain time period. PB-PK models are used to determine the potential for a chemical agent, or one of its metabolites, of ultimately reaching a sensitive cellular or molecular target to initiate a biological response. Generic PB-PK models are being made available through the Toxicology Information Network (TOXIN), Duke University Medical Center (Durham, N.C.).

A draft report, based on a literature review of pharmacokinetic models, will be ready May 1991. Future work with available pharmacokinetic models will be defined through identified requirements for such models by the Water Resources Branch and/or Regional offices.

Ron Boone (416) 323-4962

#### Data Analysis and Hardware/Software Purchase and Maintenance

This project is an ongoing activity. Data analyses have been completed for the St. Marys River MISA study and the Toronto Waterfront RAP. Graphical presentations have been developed for several projects including the Toronto Waterfront, Jackfish Bay and the Collingwood RAP. Hardware/software purchases include upgrades for faster processing and smoother operation of a modelling work station, a letter quality printer for the RAP program, 2 laser printers for Section use and 8 PCs to replace outdated equipment.

Mary Kirby (416) 323-4957

#### Data Management

This is an ongoing project to edit the data and maintain the quality of the Great Lakes Section portion of SIS. Included in this project is the development of a computer program to search the Station Description File of SIS for historical sampling locations in an Area of Concern. This program has been completed.

Mary Kirby (416) 323-4957

#### Development of Statistical Methods for Data Below Detection

A scientific paper on multiple censoring, where the data lie within known intervals, was presented at the Canadian Hydrology Symposium 1990. A draft summary report documenting the methodology of a) analyzing multiple censored data, and b) a one-way analysis of variance with censored data, has been written.

A computer program which performs a two-way analysis of variance with censored data has been developed. A multiple comparisons procedure has been incorporated into the program.

Mike Walsh (416) 323-4946

#### QA/QC Methods Development

A QA/QC survey in Humber Bay has been scheduled for the beginning of September. This survey will assess the amount of variability introduced into the data due to field procedures. Multiple split samples will be taken in the field. Arrangements have been made for the lab to perform triplicate analyses on each sample in order to estimate the variance component due to lab procedures, which is required to estimate the variance component due to field procedures.

Mike Walsh (416) 323-4946

### 3. GREAT LAKES COMPLEMENTARY PROGRAMS

In addition to the programs and Great Lakes Section activities described previously, other Sections in the Water Resources Branch conduct surveillance work on the Great Lakes and connecting channels. These programs contribute significantly to the knowledge of environmental conditions in the Great Lakes and are called upon frequently by Great Lakes Staff to provide complementary information. These major programs are:

- Tributary Monitoring
- Drinking Water Surveillance
- Sport Fish Contaminant Monitoring
- Nearshore Young-of-the-Year Fish Contaminants Monitoring
- Cladophora Contaminants Monitoring
- Water Works Intake Monitoring

## APPENDICES



## **APPENDIX A: LIST OF 1990/91 PUBLICATIONS**

- Anderson, J. 1990. St. Lawrence River Environment Investigation. Volume 4. Assessment of Water and Sediment Quality in the Cornwall Area of the St. Lawrence River, 1985. Ontario Ministry of the Environment Report.
- Barton, D.J., Martin, I.D., and Tudorancea, C.V. 1990. Data Report: 1989 Benthos Analysis at Niagara Long-Term Sensing Sites. Consultant report submitted to the Ontario Ministry of the Environment, March 1990.
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- Sherman, R.K. 1990. Presentation of Duffin's Creek pollution investigation test case to two Grade 6 Science classes at Lakeside Public School, Ajax, Ontario, February 5, 1990.
- Sherman, R.K. 1990. Presentation of the Severn Sound Remedial Options Discussion Paper to the press (initiating public review of Options Discussion), held at the Wye Marsh Wildlife Centre, Midland, Ontario, June 12, 1990.

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Sherman, R.K. 1990. Presentation of the Severn Sound Remedial Options to the Town of Midland Council, held at the Town of Midland Council Chambers, August 27, 1990.

Sherman, R.K. 1990. Presentation of the Severn Sound Remedial Options to the North Simcoe Soil and Crop Improvement Association Annual Meeting, held at Elmvale, Ontario, December 7, 1990.



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